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III.

History and Transformations of CORYDALUS CORNUTUS.

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(*With a Plate.*)

(*Communicated to the Academy, November 8th, 1848.*)

THE study of the Neuroptera has of late years received a new impulse from the works of Pictet, Charpentier, De Selys-Longchamps, Siebold, and others. This order of insects is well represented in North America, which furnishes a considerable number of species still unstudied, besides several forms whose history is essential to a proper understanding of the order; so that, if the naturalist whose location is beyond the bounds of Europe is surrounded with difficulties arising from the want of access to extensive libraries and national collections, he has counterbalancing advantages in being able to add to the knowledge of species already known, or of pursuing his investigations in an independent direction.

The transformations of *Corydalus cornutus*, *Linn.* seem not to have been hitherto made known; although, from its size and the singularity of its appearance, it has for a long time attracted attention. In Pennsylvania it appears in the perfect state in July, or a little earlier, and scarcely reaches the month of August before it disappears for the season. It is not abundant, and although the larvæ and pupæ are sufficiently common, many perish before the final transformation. I have seen as many as ten perfect individuals in a season, of which the males exceed the females at least tenfold. An entomological friend informs me that during three years he has seen about twenty, of which but one was a female. Although well known to most people in the localities where it is found, I have never been able to discover that it has a vernacular name, either in English or German. As regards vulgar names in books, appearances seem to indicate that the vernacular crudities which deface the pages of so many European works will not be likely to make their appearance very soon upon the western side of the Atlantic.

This insect may be seen upon a wall about sunset, resting perfectly still, the head in a line with the body, which rests flat, probably waiting for the darkness of night to take flight, as it does not usually take wing during the day. It is easily captured, being very sluggish in all its movements, walking and flying heavily; and if dislodged from an elevated position, it falls to the ground with outspread wings, without making an effort to escape by flight. When disturbed, a threatening aspect is assumed; the shining hemispherical eyes are conspicuous, the head and thorax are elevated, and the mandibles are opened and closed upon objects with sufficient force to puncture the skin, although incapable of inflicting any serious injury. The repugnance to the general appearance is heightened in the endeavour to capture the insect, which would naturally be attempted by a seizure upon the back; but the jaws are ready at every point, and by means of the well-developed *elevatores capitis et prothoracis* muscles, the head and thorax are turned so far over the back as to form a circle with the upturned abdomen. If the capture be persisted in, the wings expand, and a white fetid liquid excrement is ejected; the quality of which indicates the use of animal food, although I am not aware that food is taken in the perfect state. These observations apply to both sexes.

1. LARVA. (Pl. I. Fig. 1.)

The larva is oblong, depressed, tapering towards the posterior extremity; dark-brown, marked on the head and thorax with flavous impressed punctures and confluent depressions; head above and below, with the entire thorax above, of a corneous texture. Abdomen soft, the integument thick and tough, eight segments with lateral (imperforate?) spiracles and branchiæ, each of the latter composed of several filaments; ninth segment without branchiæ, except upon the divided caudal appendage, each division of which has a simple filament, and a pair of curved hooks. The prothoracic spiracle is situated in the connecting skin between the prothorax and mesothorax. The inferior surface of the ninth abdominal segment has a velvet-like pad, a smaller one being also attached to each division of the caudal appendage. The seven anterior abdominal segments have each, near the insertion of the lateral branchiæ (fig. *b*), an inferior brush or bundle of short fibres (*b'*) which seem to be accessory branchiæ. The setæ upon the lateral branchiæ are slender, whilst those upon the accessory branchiæ are short, thickly set, and somewhat flattened.

The head is transversely subquadrate and depressed; the clypeus and labrum (fig. 2) prominent; eyes (fig. 1, *a*) lateral, not prominent, simple, each composed of six lenses. Immediately anterior to these are the antennæ, which are small, composed of four cylindrical articulations, the basal one of which is solidly attached to a small oval scapus (*s*)

which moves freely in the torulus (*t*). The mandibles (fig. 2, *m*) are robust, with the apex strongly 4-dentate. Maxillæ (fig. 3, *m'*) composed of a short cardo, and a straight stipes flattened above and convex below, the sides parallel and the inner margin ciliated, the apex rounded, with two articulate projections representing the labial palpi and maxillary lobe. The former is composed of three, and the latter of two articulations. The labium (*l'*) is corneous, transverse, with the margin undulate, and it has small 3-articulate palpi. Figure 2 represents the superior, and figure 3 the inferior part of the head enlarged, with the form of the various parts as they are exposed by the separation of the sutures, when the external parts are cast off to enter the pupa state. In figure 2 the labrum, clypeus, post-clypeus, mandible, and antennæ are apparent; the post-clypeus separated from the epicranium, from which a small piece is detached by a suture posteriorly. Figure 3 exhibits the corresponding inferior parts, with the separation of the epicranium.

Habits. — The larva is predaceous and aquatic, walking upon the bottom, and not very active. Its locomotion is forwards, but when it is disturbed, it draws itself rapidly backwards by means of the caudal hooks, which are attached to the surface, and the body drawn up. When disturbed, it exhibits the propensity of the imago to bite. The head is sometimes cleaned by passing the anterior feet over it. It is found in the spring of the year from a short distance to fifty feet or more from the water, where it takes refuge beneath a stone or log, forming an oval cavity in the earth, where it remains some time (probably not less than two weeks) awaiting its change. It will live in confinement four or five days without being wet, so that it is probable that the spiracles are used for aerial respiration.

Sexes. — In the male larva (and also in the pupa) the head and mandibles are a little larger than in the female, although the form is identical; and it has a small tubercle upon the middle of the prosternum near the insertion of the feet, somewhat resembling that in the orthopterous genus *Acrydium*. Figure 1 represents a male larva when full grown.

2. PUPA. (Pl. I. Fig. 4, 5.)

The body of the pupa is curved in a semicircle, and it becomes narrower and more nearly cylindrical, the chief difference (when compared with the larva) being apparent in the prothorax and abdomen. The head resembles more nearly that of the adult, except the mandibles, which are toothed in both sexes, and do not differ essentially from those of the larva. An elevated ridge extends backwards from the posterior portion of the eyes (fig. 5). The wings are deflexed, and, with the feet, rest loosely upon the breast.

The antennæ are about three fourths of an inch long, curving over the posterior angles and beneath the head, and the articulations are much contracted. Labium (fig. 6, representing the head beneath) fleshy and bifid, each side obtusely rounded; labial palpi 3-articulate, last articulation fusiform and acute. Maxillæ with two fleshy lengthened triangular lobes, the inner one smallest, the external one with a small spine at the apex; maxillary palpi with five short articulations. Most of the external parts are covered with scattered hairs.

To allow the imago to escape, the integument of the pupa splits transversely behind the antennæ, and longitudinally from this line to the metanotum, into which the cleft is continued for a very short distance.

Habits. — The insect does not remain long in the pupa state, in which it is inactive, although capable of moving the body in a small degree. Near the period of its final change, however, it acquires the power of walking, although in a very feeble manner; and it seems probable that this power is seldom used.

3. IMAGO. (Pl. I. Fig. 7.)

The general color is gray; the head and thorax brownish, these variegated with spots of pale-flavous. The head and prothorax are minutely scabrous, except the portions spotted with flavous, a character which approximates the imago to the larva. The color of the recent insect scarcely differs from that of cabinet specimens.

Prothoracic spiracle (fig. *e*) resembling, like the others, a bivalve shell, but it has the addition of a fleshy pad covered with long hairs, placed at its lower point. Eyes hemispherical, three fourths of a line in diameter; size of the facets .01 of a line, or not more than half the size of those in *Libellula* and *Aeshna*. The heart makes from 36 to 40 pulsations in a minute. The feet are weak and slender, and the tarsi (*t*) pentamerous.

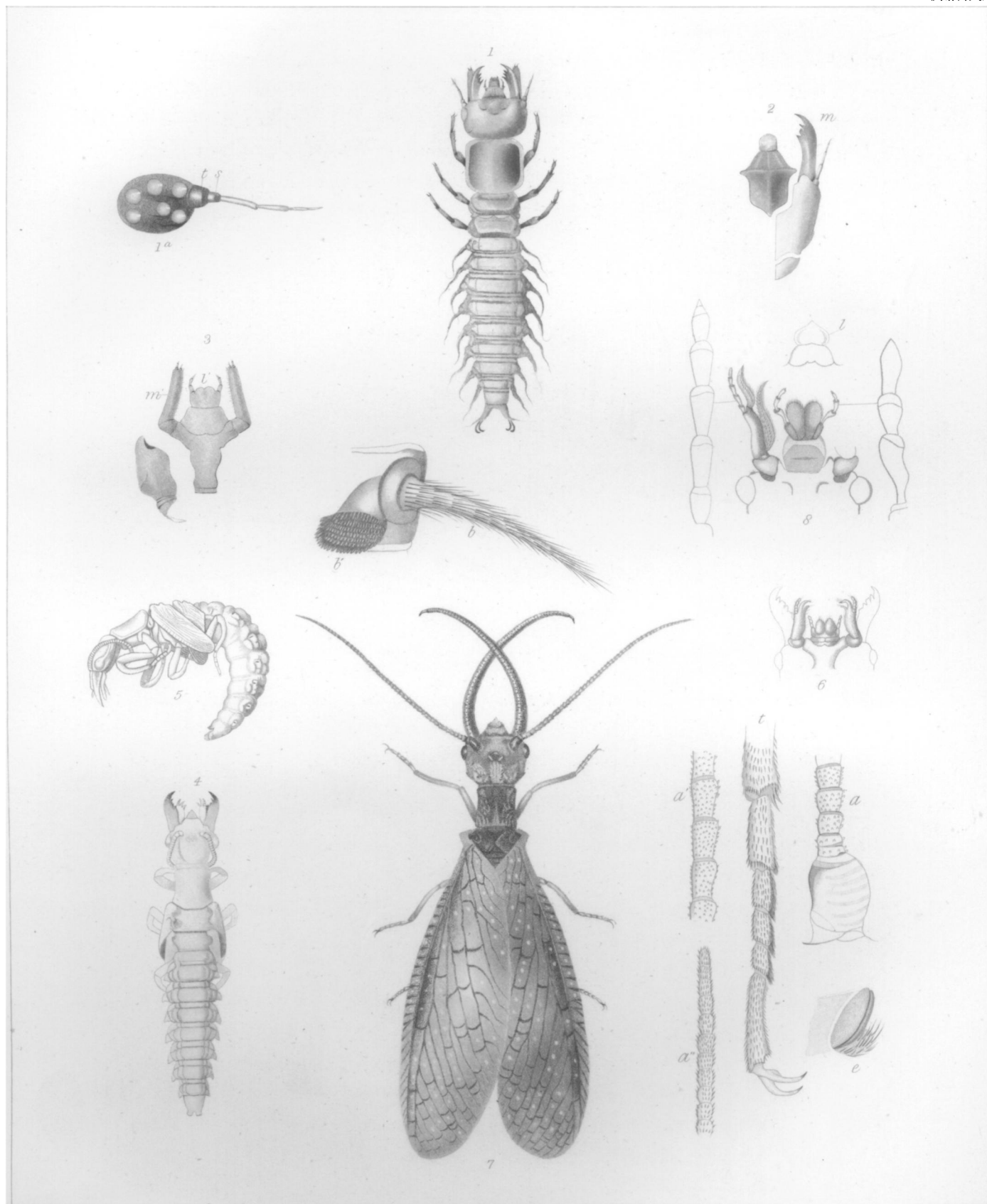
The most important peculiarity in the structure of the perfect insect is a complete perforation through the head at the anterior base of each antenna, mentioned by me in the *Proceedings of the Academy of Natural Sciences of Philadelphia*, Vol. II. p. 192. They are present in both sexes, and are sufficiently large at the narrowest part to admit a bristle, and from this point they enlarge upwards and downwards. They are situated at the internal extremity of a transverse impression above, and in the angle of a curved fissure beneath, which separates the post-mentum from the cranium. They are represented by the semicircular lines shown between the eyes, in figure 8. There is no interruption in the solid exterior of the head as it passes through and lines this perforation, so that thus far it has afforded no additional information as to the functions of the antennæ.

The three ocelli are arranged in a triangle, the anterior one being directed forwards, and the others diagonally outwards and backwards. There is a small spine behind the eye, and another larger one at the posterior angles of the head. Except the mandibles, the oral organs are soft and membranaceous. They are represented by figure 8, and the labrum at *l*.

Sexes. — In the male (fig. 7) the antennæ have about 60, and in the female 54 articulations, so that they are a little longer in the former sex, which has the apex of the abdomen provided with two pair of forceps. The mandibles in the male are large, somewhat depressed at base, tapering and arcuate, resembling horns; they are three times the length of the head, and somewhat irregular in form and direction. They are round except at the apex, which is pointed, and notched so as to present a sharp, cutting edge, less than a line in length. This peculiarity is not represented by M. Blanchard in the new edition of the *Règne Animal*, pl. 104, fig. 1. That author figures the head of the female on the same plate, fig. 2, and it is represented in Dr. Leidy's dissections of the imago. Figure *a* represents the base, and *a'* the middle portion of an antenna in the male, and *a''* the apex in the female.

The form and armature of the mandibles in the female resemble those of the earlier stages. It is a remarkable circumstance, that sexual peculiarities as distinct as those presented in the mandibles of this genus should not be conspicuous in the early stages; and the fact that these organs are essentially the same in the larva, pupa, and female imago, affords an additional proof to the opinion that the female is an undeveloped condition of the male sex.

The earlier form of the orthography of the name, *Corydalus*, is preferable to that of *Corydalis*, which is homonymous with that of a genus of plants.



TRANSFORMATIONS OF CORYDALUS CORNUTUS